



## SAFETY DATA SHEET

### URANIUM OXIDE

(UO<sub>2</sub>)

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#### SECTION 1: CHEMICAL PRODUCTS & COMPANY IDENTIFICATION

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NBL Program Office  
U. S. Department of Energy,  
1 Science.gov Way,  
Oak Ridge, TN 37830  
1-865-576-0598

**Emergency Phone Numbers:** 1-865-576-0598

**Chemical Name:** Uranium oxide (UO<sub>2</sub>)

**Other Identifiers:** C.I. 77915; UO<sub>2</sub>; CRM 125; CRM 125-A; Uranium Fuel Pellet, Safeguards Measurement Evaluation Program UO<sub>2</sub>.

**Use and Restriction:** This material is prepared for use as a standard or in inter-laboratory comparison programs at analytic laboratories, which routinely handle uranium. New Brunswick Laboratory (NBL) expects that recipients of this material are in compliance with 29 CFR 1910.1200(h) which require employers to provide employees with effective information and training on hazardous chemicals in their work area.

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#### SECTION 2: HAZARDS IDENTIFICATION

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**OSHA Hazards**

Toxic by inhalation, toxic by ingestion.

**Target Organs**

Kidney, Liver, Lungs, Brain

**GHS Label Elements**



**Pictogram:**

**Signal Words:** Danger

**Hazard Statements:** Fatal if swallowed or inhaled  
Toxic by inhalation and ingestion  
Danger of cumulative Effects May damage kidneys  
Very toxic to aquatic life

**Precautionary Statements:** Avoid breathing dust  
Avoid contact with skin, eyes and clothing. When using do not eat, drink or smoke  
In case of accident or if you feel unwell seek medical advice immediately  
Use only with adequate ventilation

**Other Hazards:**



Radioactive

**GHS Classification**

Skin Irritation (Category 2)

Eye Irritation (Category 2)

Specific target organ toxicity – repeated exposure (Category 2)

Specific target organ toxicity – acute exposure (Category 2)

**GHS Hazard Ratings**

R23/25: Toxic by inhalation and ingestion R33: Danger of cumulative effects

S20/21: When using do not eat, drink or smoke

S45: In case of accident or if you feel unwell seek medical advice immediately S61: Avoid release to the environment

**CERCLA Ratings (SCALE 0-3):**

HEALTH=3

FIRE=0

REACTIVITY=0

PERSISTENCE = 3

**NFPA RATINGS (SCALE 0-4):**

HEALTH=3  
FIRE=0  
REACTIVITY=0

**CARCINOGEN STATUS:**

OSHA: N  
NTP: N  
IARC: N

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SECTION 3: COMPOSITION/INFORMATION ON INGREDIENTS

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**Chemical Name:** Uranium Oxide (UO<sub>2</sub>), 100%

**Common Names/Synonyms:** URANIUM OXIDE (UO<sub>2</sub>); URANIA; URANIUM DIOXIDE; URANOUS OXIDE; URANIUM(IV) OXIDE; URANIA (UO<sub>2</sub>); URANIUM (4+) DIOXIDE; BLACK URANIUM OXIDE; GAMMA-URANIUM DIOXIDE;

**CAS Number:** 1344-57-6

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SECTION 4: FIRST AID MEASURES

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**INHALATION:** Conscious victims should immediately leave the area of airborne contamination, move to a restricted area for evaluation and decontamination, and ask facility safety personnel for assistance. Before entry into areas of airborne contamination, rescuers should don respirators with high-efficiency particulate filters or self-contained air supply. If victim's breathing has stopped, perform artificial respiration; if possible use mechanical means, which prevent contamination of the rescuer.

A nasal swab should be obtained by trained (radiation) safety personnel. After obtaining the swab, the victim should be instructed to cough and blow his nose to eliminate as much material as possible, and to wash or wipe his face. Obtain medical assistance immediately. The victim and victim's clothing, personal items, and equipment should be monitored for external contamination. If delay will not impact the health of the victim, decontamination should be started before the victim is moved to the medical area. Rescue and safety personnel who enter the contaminated area or assist the victim should be monitored for contamination and decontaminated if necessary.

**SKIN CONTACT:** Inform facility safety personnel and follow all instructions. In general, the victim should thoroughly wash the contaminated area with soap and water, taking special care to clean body crevices such as fingernails. The victim should monitor for residual contamination or be monitored by another person, as called for by site safety documents. Skin injuries and abrasions increase the danger that uranium may penetrate the skin. It is best not to shave the victim or to use harsh brushes. If water and soap have not removed the uranium, seek expert advice. Do not apply organic solvents, which may be toxic, may be absorbed through the skin, and may increase the solubility and absorption of the uranium.

Skin contamination may indicate that material inhalation, ingestion, or contamination of clothing or equipment has occurred. Contaminated clothing, personal items, or equipment must be cleaned or discarded. The water used for decontamination procedures must be treated as if it contains radioactive materials and treated or disposed of appropriately. Rescue and safety personnel who come in contact with a contaminated area or victim should be monitored for contamination and decontaminated if necessary.

**EYE CONTACT:** Immediately flush the eyes with large amounts of water for at least 15 minutes, occasionally lifting the upper and lower lids. If available, follow with an isotonic solution. Obtain medical assistance immediately. If delay will not impact the victim's health, monitor the victim before transfer to the medical facility and, if necessary, decontaminate clothing, personal items, and skin. Any water or other cleaning agents used in decontamination procedures must be suspected of containing radioactive material and treated or disposed of accordingly. Rescue and safety personnel who enter the accident area or assist the victim must be monitored for contamination and decontaminated if necessary.

**INGESTION:** Immediately rinse the mouth, being careful that the victim does not swallow the water used for this purpose. Uranium is not easily absorbed from the digestive system, but is a more dangerous hazard when inhaled. Therefore, it may be better to remove stomach contents by pump than by vomiting. Obtain medical advice and assistance immediately. If medical advice or assistance is not immediately available, vomiting may be induced; care should be taken to avoid aspiration of vomitus. Do not induce vomiting in an unconscious person. Vomitus and lavage fluids can assist safety personnel in determining the level of exposure and should be saved for later examination. The victim should be monitored for contamination of the skin or clothing. If delay will not impact the victim's health, decontamination should be attempted before the victim is transported to a medical facility. Rescue and safety personnel who enter a contaminated area or assist a contaminated victim should be monitored for decontamination.

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## SECTION 5: FIRE FIGHTING MEASURES

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**Suitable Extinguishing Media:** Dry chemical, carbon dioxide, water spray, or regular foam. (See the most recent *Emergency Response Guidebook*, (ERG), developed jointly by Transport Canada (TC), the U. S. Department of Transportation (DOT) and the Secretariat of Transportation and Communications of Mexico (SCT).)

**Fire and Explosion Hazard:** Negligible fire hazard when exposed to heat or flame.

**Hazardous Combustion Products:** Thermal decomposition may release toxic/hazardous gases.

**Special Protective Equipment and Precautions for Fire-Fighters:** Wear NIOSH/MSHA approved self-contained breathing apparatus, flame and chemical resistant clothing, hats, boots, and gloves. Move container from fire area if you can do it without risk. Cool container with water from maximum distance.

Contact local, state, or Department of Energy radiological response team. Avoid breathing dusts and fumes, keep upwind. Delay cleanup until instructions are received from Radiation Authority. Keep unnecessary people out of area until it is declared safe by proper authorities.

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## SECTION 6: ACCIDENTAL RELEASE MEASURES

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**Personal Precautions and Protective Equipment:** Do not touch damaged containers or spilled material. Damage to outer container may not affect primary inner container.

**Emergency Procedures/Methods and Materials for Containment and Clean-up:** Inform facility safety personnel. Untrained personnel should not touch damaged containers or spilled material. Undamaged packages may be moved to a radiologically controlled area for monitoring and decontamination, if necessary. Small spills may be cleaned up using a HEPA filtered vacuum cleaner. Large spills may be settled by sprinkling with water and diked for later disposal. Stay upwind; keep unnecessary people away. Delay clean up until arrival or instruction of qualified Radiation Authority.

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## SECTION 7: HANDLING AND STORAGE

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**Precautions for Safe Handling:** Avoid contact with skin, eyes and clothing. When using do not eat, drink or smoke. Avoid breathing dust. Wash thoroughly after handling. Use only with adequate ventilation.

The route of entry of UO<sub>2</sub> into the body which is potentially most serious, and is also most likely if exposure is accidental, is through inhalation.

Facilities, which use radioactive materials such as uranium, must examine their operations for occupational hazards including chemical toxicity, radiation exposure, and radioactive contamination. Operations which have the potential for producing airborne particulate or powdered uranium materials must be conducted only in HEPA filtered fume hoods or HEPA filtered glove boxes and monitored by CAAM or personal sampler as appropriate. When airborne contamination is possible, personnel in the airborne contamination area must be provided with appropriate protective gear including eye protection and respirators with high-efficiency particulate filters or self-contained air supply.

Facilities and laboratories, which use or handle uranium materials must develop safety programs which have been approved by appropriate regulatory bodies and include emergency and accident response procedures. Personnel who work with radioactive materials must pass appropriate training in handling procedures. Trained radiation safety personnel must be on call during all procedures, which have the potential for harm to personnel or facility assets.

Uranium is a radioactive material, which decays primarily by emission of alpha particles and gamma radiation. Beta radiation is emitted by uranium decay products, which are present in most uranium materials. Alpha particles are not highly penetrating; the outer skin layer protects internal tissues from damage due to an external source of alpha particles. However, alpha radiation can be extremely dangerous to cells immediately adjacent to the source of radiation. Therefore, extreme care should be taken to avoid inhalation, ingestion, or contact with an open wound or sore. Facilities which handle uranium must evaluate the potential for harmful exposure to radiation and shield workers to comply with ALARA (As Low As Reasonably Achievable) requirements.

Care should be taken to prevent accidental ingestion of uranium materials. Protective clothing, including lab coats or disposable coveralls and safety glasses or goggles, must be worn. When operations are such that splashing, splattering, or other types of contamination may occur, users should wear disposable gloves and shoe covers. Solids and solutions should not be allowed to contact eyes, skin or clothing.

Personnel who could become contaminated by uranium materials should wash and monitor their hands before touching their face, personal clothing, eyeglasses, pens, laboratory notebooks, or laboratory instruments or equipment. Surfaces, which could become contaminated, must be cleaned and monitored for radioactive contamination on a regular basis. Personnel should not eat, drink, smoke, chew gum, apply cosmetics, or perform any other action which could lead to inhalation or ingestion of radioactive materials while within a room or area in which such materials have been stored or used.

**VENTILATION:** When working with dry powders, provide process enclosure ventilation. Depending upon the specific workplace activity and the radioactivity of the isotope, a more stringent ventilation system may be necessary to comply with exposure limits set forth by law (10 CFR 20.103).

**RESPIRATOR:** Follow the recommendations given in the NIOSH *Pocket Guide to Chemical Hazards* (U.S. Department of Health and Human Services, available through the U.S. Government Printing Office); NIOSH criteria documents or 29 CFR 1910 Subpart Z (U.S. Department of Labor).

The specific respirator selected must be based on contamination levels found in the work place, must not exceed the working limits of the respirator and be jointly approved by the National Institute for Occupational Safety and Health and the Mine Safety and Health Administration (NIOSH/MSHA).

**FOR FIREFIGHTING AND OTHER IMMEDIATELY DANGEROUS TO LIFE OR HEALTH CONDITIONS:** Use a self-contained breathing apparatus that has a full face piece respirator with a high-efficiency particulate filter. Alternatively, use a supplied-air respirator with a full face piece and operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained breathing apparatus.

**Conditions for Safe Storage:** Store in radioactive materials area. Keep storage container tightly closed. Store separately from incompatible materials. Observe all Federal, State, and local regulations when storing this substance.

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## SECTION 8: EXPOSURE CONTROLS/PERSONAL PROTECTION

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### **Exposure Limits:**

Uranium, insoluble compounds (As U):

0.05 mg/m<sup>3</sup> OSHA TWA (soluble), ; 0.25 mg/m<sup>3</sup> OSHA TWA (insoluble)

0.2 mg/m<sup>3</sup> ACGIH TWA; 0.6 mg/m<sup>3</sup> ACGIH STEL

0.2 mg/m<sup>3</sup> NIOSH Recommended TWA; 0.6 mg/m<sup>3</sup> NIOSH Recommended STEL

10.0 mg/m<sup>3</sup> as U NIOSH IDLH

Occupational exposure to radioactive substances must adhere to standards established by the Occupational Safety and Health Administration, 29 CFR 1910.96, and/or the Nuclear Regulatory Commission, 10 CFR Part 20. For DOE and its contractors 10 CFR 835, Occupational Radiation Protection must be followed.

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## SECTION 9: PHYSICAL AND CHEMICAL PROPERTIES

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**Appearance:** Brown to copper-red to black crystals.

**Odor:** N/A

**Odor Threshold:** N/A

**pH:** N/A

**Molecular Weight:** 270.03

**Molecular Formula:** UO<sub>2</sub>

**Melting Point:** 5176-5248°F (2858-2898°C)

**Specific Gravity:** 10.96

**Water Solubility:** Insoluble

**Solvent Solubility:** Soluble in nitric acid and concentrated sulfuric acid. Insoluble in dilute acids.

**Chemical Family:** metal oxide, radioactive.

**Vapor Density:** Data not available

**Vapor Pressure:** Data not available

**Auto-Ignition Temperature:** Data not available

**Decomposition Temperature:** Data not available **Viscosity:**

Data not available

**Relative Density (water = 1):** 11.0

**Flammability:** Combustible Data not available **Explosive**

**Limits:** Data not available

**Boiling point:** decomposes

**Flash Point:** Non-Flammable solid

**Freezing Point:** N/A

The half-lives of the various uranium isotopes are as follows:

$^{233}\text{U} = 1.54 \times 10^5 \text{ y}$ ;  $^{234}\text{U} = 2.47 \times 10^5 \text{ y}$ ;  $^{235}\text{U} = 7.04 \times 10^8 \text{ y}$ ;  $^{236}\text{U} = 2.39 \times 10^7$ ;

$^{238}\text{U} = 4.51 \times 10^9 \text{ y}$ .

The specific activities of the various uranium isotopes are as follows:

$^{233}\text{U} = 3.6 \times 10^2 \text{ MBq/g}$  ( $9.7 \times 10^{-3} \text{ Ci/g}$ )

$^{234}\text{U} = 2.3 \times 10^2 \text{ MBq/g}$  ( $6.2 \times 10^{-3} \text{ Ci/g}$ )

$^{235}\text{U} = 7.8 \times 10^{-2} \text{ MBq/g}$  ( $2.1 \times 10^{-6} \text{ Ci/g}$ )

$^{236}\text{U} = 2.3 \text{ MBq/g}$  ( $6.3 \times 10^{-5} \text{ Ci/g}$ )

$^{238}\text{U} = 1.2 \times 10^{-2} \text{ MBq/g}$  ( $3.3 \times 10^{-7} \text{ Ci/g}$ )

See 10 CFR Chapter 1, Pt. 71, Appendix A. SECTION 10:

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## SECTION 10: STABILITY AND REACTIVITY

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**Reactivity:** See below.

**Chemical Stability:** Stable under normal temperatures and pressures except for radioactive disintegration.

**Polymerization:** Hazardous polymerization has not been reported to occur under normal temperature and pressure.

**Conditions to Avoid:** Excessive heat.

**Incompatible Materials: Bromine Trifluoride:** Rapid reaction below 135°C.

**Hazardous Decomposition Products:** Thermal decomposition may release hazardous and toxic gases.

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## SECTION 11: TOXICOLOGY INFORMATION

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**OVERVIEW:** Uranium oxide is a brown to copper-red to black solid. Inhalation, ingestion, or absorption through skin abrasions may lead to heavy metal toxicity or radiation poisoning. Avoid inhalation or contact with skin, eyes and clothing. Wash thoroughly after handling. Use only with adequate ventilation.

### POTENTIAL HEALTH EFFECTS:

#### INHALATION:

**Short Term Exposure:** Inhalation of uranium powders may irritate the respiratory system. Exposure may cause irreversible kidney damage or acute necrotic arterial lesions. Inhalation of large particles of uranium materials or chronic exposure to uranium powders may result in radiation damage to internal tissues, especially the lungs and bones; the likelihood and extent of radiation damage increases with higher uranium enrichments.

**Long Term Effects:** In addition to effects from short term exposure, damage may include pulmonary fibrosis and malignant pulmonary neoplasia, anemia and blood disorders, liver damage, bone effects, sterility, and cancers.

#### SKIN CONTACT:

**Short Term Exposure:** Contact with uranium powders may result in dermatitis. Contact with uranium solutions may allow absorption of uranium through the skin.

**Long Term Effects:** See Short Term Exposure. **EYE**

#### CONTACT:



Short Term Exposure: Uranium powders and particulate matter may cause redness and swelling of the eyes and eye damage.

Long Term Effects: Exposure to radiation may cause cataracts.

**INGESTION:**

Short Term Exposure: Exposure may cause kidney damage or acute necrotic arterial lesions. May also affect the liver. Chronic exposures may cause radiation damage to internal tissues. The likelihood and extent of damage increases with higher enrichments and longer exposure periods.

Long Term Effects: Same effects as short-term exposure.

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**SECTION 12: ECOLOGICAL INFORMATION**

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Environmental Impact Rating (0-4): No data available Acute Aquatic

Toxicity: No data available Degradability: No data available

Log Bioconcentration Factor (BCF): No data available Log

Octanol/water partition coefficient: No data available

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**SECTION 13: DISPOSAL INFORMATION**

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Observe all Federal, State and local Regulations when disposing of this substance.

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**SECTION 14: TRANSPORTATION INFORMATION**

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The U.S. Department of Transportation (D.O.T.) Code of Federal Regulations (49 CFR Parts 100-185), the International Air Transportation Association (IATA), International Civil Aviation Organization (ICAO) and International Maritime Organization (IMDG) are all factored into the classification and transport of material.

Proper Shipping Name: Hazard  
Class:  
UN/ID Number:  
Special Information:  
Packing Group:

} To be determined on a case by case basis.

Classification of substances with multiple hazards must be determined in accordance with the criteria presented in the above mentioned regulations. Due to the various quantities/combinations of materials being shipped at one time, the information above must be determined based on the characteristics of the specific shipment.

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**SECTION 15: REGULATORY INFORMATION**

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TSCA STATUS: Y

CERCLA SECTION 103 (40 CFR 302.4):	N
SARA SECTION 302 (40 CFR 355.30):	N
SARA SECTION 304 (40 CFR 355.40):	N
SARA SECTION 313 (40 CFR 372.65):	N
OSHA PROCESS SAFETY (29 CFR 1910.119):	N
CALIFORNIA PROPOSITION 65:	N

SARA HAZARD CATEGORIES, SARA SECTIONS 311/312 (40 CFR 370.21) ACUTE

HAZARD:	Y
CHRONIC HAZARD:	Y
FIRE HAZARD:	N
REACTIVITY HAZARD:	N
SUDDEN RELEASE HAZARD:	N

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**SECTION 16: OTHER INFORMATION**

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This material is prepared for use as a standard or in inter-laboratory comparison programs at analytical laboratories, which routinely handle uranium and/or plutonium. The NBL Program Office (NBL PO) assumes that recipients of this material have developed internal safety procedures, which guard against accidental exposure to radioactive and toxic materials, contamination of the laboratory environment, or criticality. NBL PO further expects that personnel who handle radioactive materials have been thoroughly trained in the safety procedures developed by and for their Laboratory.

The information and recommendations set forth herein are presented in good faith and believed to be correct as of the revision date. However, recipients of this material should use this information only as a supplement to other information gathered by them, and should make independent judgment of the suitability and accuracy of this information. This statement is not intended to provide comprehensive instruction in developing an appropriate safety program and does not include all regulatory guidelines.

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